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QUESTIONS AND ANSWERS IN THE USE OF COAL AND OIL FUELS AND LOCOMOTIVE OPERATION

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PREFACE

THIS BOOK IS NOT A TECHNICAL PUBLICATION, BUT HAS BEEN COMPILED FOR THE USE OF THOSE INTERESTED IN LOCOMOTIVE OPERATION. IT WILL BE INVALUABLE ESPECIALLY TO THOSE ANTICIPATING PROMOTION.

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FIRST YEAR EXAMINATION.

50. What time previous to starting out should a fireman get around, and what are his duties in connection with inspecting supplies and preparing his fire before starting out on a trip?

Ans. In sufficient time to do the work required to be ready to leave at time called for. He should see that there is sufficient water in the boiler by opening a gauge-cock, a proper supply of coal and water in the tender, that ash-pan is clean, dumps, dampers, grates and their connections in working condition, one extra shovel, one slash-bar, coal pick, ash hoe and clinker hook if desired, then look after the fire, gradually building it up to suitable depth and maintaining same to meet the coming conditions.

51. What is combustion?

Ans. Combustion is the chemical union of the atoms of the coal with the atoms of the air, to effect which it is necessary that they meet at a high temperature.

52. At what temperature is combustion complete?

Ans. Above eighteen hundred degrees Fahrenheit.

53. At what temperature will water boil in an open vessel and no pressure? (a) At 200 pounds pressure per gauge?

Ans. 212 pounds, and 387 pounds, respectively.

54. What is the color of a flame when combustion is complete?

Ans. White heat.

55. What is the combustible part of coal? (a) The non-combustible parts?

Ans. Fixed carbon and gaseous matter. Non-combustible parts are ashes, sulphur and iron.

56. How much air is required to burn one pound of coal?

Ans. About 300 cubic feet of free air.

57. Why is the exhaust steam allowed to escape through the stack?

Ans. To draw the required quantity of air through the fire for each pound of coal consumed.

58. How much water should a pound of coal evaporate in light service? (a) In heavy service, and why the difference?

Ans. About 5 pounds of water. In heavy service about 9 pounds of water, the amount being controlled by the conditions under which the engine is being operated.

59. Name points on road where grates must n[illegible] shaken and why.

Ans. They must not be shaken while on bridges, trestles, culverts, cattle-guards or near buildings, to avoid fires.

60. What must be done with ashes and clinkers removed enroute?

Ans. They must be leveled down and extinguished by water.

61. What is the objection to carrying fire or red-hot clinkers on face of grates, in ash

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pans and smoke boxes? (a) Why will clinkers on the grate prevent full steam pressure?

Ans. Because clinkers prevent the flow of air through the fire and fire in ash pans will warp their walls, and is liable to burn out the grates and connections, and is also conducive to the overheating of the rear axle bearings. (a) Fire in smoke boxes is liable to warp front end.

62. What causes clinkers to form around flues and stay bolts?

Ans. Clinker is formed by the fusion of the impurities in the coal. Expansion and contraction of flues and fire box sheets causes them to seep; the moisture around the stay bolt heads and end of flues aids the clinker to stick fast. With coal containing these impurities clinker will form though fire box be perfectly dry.

63. What is the largest size lump of coal that may be applied to a fire?

Ans. Should not exceed 5 inches in thickness.

64. How should coal be applied to a fire when engine is working?

Ans. Commence in time, put fire in leisurely, allowing the door to remain closed a brief interval between each shovelful for the furnace to regain its temperature.

65. Why must fire-door be closed following each shovelful applied to fire when engine is working?

Ans. Because the inrush of air causes rapid cooling and contraction of the fire box sheets and is injurious to flues and flue sheet.

66. Why should the steam pressure not be allowed to drop more than ten pounds when engine is working?

Ans. The variation in pressure causes contraction and expansion which is injurious to flues and stay bolts, causing them to leak.

67. What is black smoke and how may it be eliminated?

Ans. It is a mixture of gases and carbon. With engine properly drafted and a fair grade of coal, by firing light and often.

68. Do you understand that black smoke is prohibited around stations and city limits?

Ans. Yes.

69. How may smoke be prevented when engine is not working?

Ans. By the proper use of the blower and opening the door slightly.

70. What are the indications when a fire burns with a dull red color?

Ans. Combustion is incomplete.

71. Why is it extravagant and harmful to apply too many scoopfuls of coal at a time?

Ans. Because a large quantity of coal thrown on the fire is at first a great absorbent of heat, produces black smoke, cools the fire box and flues, causing contraction, followed by an intensely hot fire, causing expansion which results in leaky flues, broken stay bolts and general injury to the boiler.

72. What should be the condition of the fire and water level in boiler when starting?

Ans. Fire should be in good condition so as to keep door closed while engine is working hard forcing the train into speed. The water level should be uniformly high, but

not sufficient to work over into the valves and cylinders.

73. What should be the condition of the fire when engine is about to descend a long grade?

Ans. In such condition as will maintain an even pressure. If necessary to inject water into boiler, blower must be used to thoroughly heat same.

74. What is the effect on the working of the fire if a number of flues are choked in one place?

Ans. Will cause holes to be torn in fire when engine is working hard.

75. What adjustments are necessary when more coal is consumed in the front than in the rear of the fire box?

Ans. The diaphragm should be raised.

76. What is the effect on the fire if too little air enters through the grate?

Ans. Combustible gases escape unburned, and fire will burn slowly.

77. By whose authority may draft appliances in smoke box be readjusted?

Ans. By authority of the Supt. of Motive Power upon the approval of the Master Mechanic or Road Foreman of Equipment.

78. What is the evil effect of allowing steam or air leaks in smoke box?

Ans. Steam leaks in smoke box will prevent steaming of engine.

Air leaks may cause the cinders to ignite and damage the front door or smoke box.

79. What might result in starting a heavy train with fire too low?

Ans. It is liable to lift fire from the grates, tearing holes in the fire, admitting cold air, reducing fire box temperature, causing a reduction of boiler pressure.

80. When and why should a fire be applied enroute in suburban service?

Ans. Should be applied immediately after the engine has started to avoid black smoke around depots.

81. What should be the water level in boiler prior to cleaning the fire? (a) Why should not the injectors be used during the process of fire cleaning or thereafter?

Ans. Maximum level. (a) Pressure would be reduced causing contraction of fire box sheets, resulting in leaky flues and stay bolts.

82. Why must water not be fed to the boiler when engine is starting a train?

Ans. Because fire is not in condition to heat fresh supply of water and maintain the pressure.

83. How should the water level be varied when frequent stops are made?

Ans. It should be allowed to lose enroute, but not more than can be regained while standing without loss of pressure.

84. What damage will result if water is not kept on the crown sheet?

Ans. It will become overheated and be forced down by the pressure above it.

85. Why must the tender not be overloaded with coal?

Ans. It would make tank top heavy and be shaken off, resulting in loss of fuel and possibility of doing personal injury.

86. Describe the blower and its use.

Ans. The blower valve is connected at the fountain and connected to the stack by means of a pipe. Its purpose is to create a draft when the engine is not working steam, the draft being induced chiefly by the friction of the particles of steam against the particles of gases in the smoke box and stack.

87. Why is the slipping of driving wheels both damaging to the fire box and the locomotive generally?

Ans. From the fact that the driving wheels and rods together with the other machinery dependent upon them for the regular and even movement of the locomotive are turned loose at a rapid rate without any check on their momentum except such as the strength of the material can offer with the straining effect upon it. An excessive amount of air is drawn through the grates, decreasing the temperature in the fire box, which has its effect upon flues and fire box sheets.

88. Explain the construction of a locomotive boiler.

Ans. The principal parts of a boiler are: The fire box, boiler barrel or waist, smoke box, smoke stack and steam dome. The side sheets of the fire box are staid to the outer shell of the boiler by stay bolts which are threaded and screwed into places previously drilled and tapped. The crown sheet is supported either by crown bars or radial stays.

89. Explain the principal parts of safety valves and their purpose.

Ans. Valve casing, spring and screw bolt. It relieves the boiler when maximum pressure is reached.

90. What must be done when it is found that the water level in the boiler has become dangerously low?

Ans. Fire must be extinguished.

91. What is the effect of mud and scale formation in a boiler?

Ans. The scale acts as a non-conducting coat to the heating surfaces and consequently is a waste of heat and tends to cause the surfaces to overheat.

92. What effect has a small nozzle tip on the fire? (a) On the working of the engine?

Ans. Creates strong draught, consumes more coal; increases back pressure in cylinders.

93. How would you take care of a boiler with leaky flues or fire box enroute?

Ans. Try to keep a light hot fire at all times, thus keeping the sheets from cooling and contracting.

94. What causes foaming in boilers?

Ans. May be due to the presence of impurities in the water, such as alkali or soda in excess, grease, soap and some kinds of oil.

95. What may be done to reduce foaming enroute?

Ans. Frequent use of blow-off valve and use of such compounds as is permissable.

96. What would you do if the steam whistle, blow-off cock or hand hole plate should blow out of boiler?

Ans. Start both injectors and extinguish fire, when pressure is relieved it may be possible to make repairs, fill boiler fire up and proceed. If steam whistle blew out keep water

to safe level, let fire die down; when pressure is relieved, plug opening and proceed.

97. Why is it injurious to machinery to work water in cylinders of engines, especially those having piston valves?

Ans. There is danger of knocking out cylinder heads, breaking pistons and packing rings, breaking eccentrics and eccentric straps especially with piston valves, as they cannot lift by the pressure of the water underneath.

98. Do you consider it improper to run with two or more water gauge cocks stopped up?

Ans. Yes.

99. Should you depend entirely upon the water glass for carrying the water in the boiler?

Ans. No.

100. Why should the fireman keep a constant watch on the water level in the boiler?

Ans. That he may keep the fire in condition to heat the water to be injected into the boiler and maintain an even temperature.

101. What may be done in the way of repairs to a broken grate enroute?

Ans. It may be possible to prop grate up. If not, iron bars or even rock may be used to cover or fill opening sufficient to hold fire.

QUESTIONS ON OIL BURNING.

102. What is the difference between a coal and an oil burning locomotive?

Ans. It is necessary to remove the diaphragm, netting grates and connections, and substitute the ash pan for one of special design and coal space on tender fitted with oil tank.

103. Where is connection made to locomotive boiler for receiving steam supply from stationary plant?

Ans. To valve in cab.

104. At what pressure should stationary plants be cut off and boiler allowed to supply its own steam?

Ans. Twenty or more.

105. How, and under what conditions may wood be used?

Ans. In the absence of steam or air supply a fire of wood may be carefully laid, but must be entirely consumed before engine starts on a run, otherwise the sparks may cause damage to property.

106. Describe the oil burner, operation, possible defects and remedies therefor.

Ans. It is a simple casting containing long ports with an extension lip. The upper port is for the passage of oil and the lower for steam. The lip is to aid the steam in atomizing and spreading the oil, which, when properly mingled with the air and ignited, will produce

combustion. It must be inspected and note that burner is adjusted so that blaze will strike the lower portion of the flash wall, that the mouth of the burner is free from carbon and slag.

107. What is the purpose of the fire brick, and how are they located?

Ans. To aid in proper combustion and consequent good steaming. They are located in ash pans extending to sufficient height around the walls of the fire box.

108. What is the purpose of the emergency cord?

Ans. To be used in case of accident or fire in ash pans when standing, or otherwise when it is desired to quickly stop the flow of oil from tank.

109. Why should lights not be used around oil tank opening?

Ans. To prevent the liability of fire and explosion.

110. How is the fireman's oil supply valve constructed?

Ans. It is of the ordinary plug cock type having "V" shaped ports.

111. Describe the positions for the handle on fireman's oil supply valve.

Ans. It is closed when handle is to the extreme left, and wide open when to the extreme right.

112. Explain how to leave a locomotive at terminal and end of trip.

Ans. Securely close all steam and oil valves and ash pan damper; drip valves "I" and "Q" open.

113. When and how are the flues to be sanded?

Ans. Often enough to prevent an accumulation of soot. Continue to use sand as long as soot and black smoke prevail. It is done when engine is working by placing the mouth of the funnel in the hole in the fire door, moving it about, endeavoring to have sand reach all flues.

114. How are the fires to be started, or re-started?

Ans. See that there is the proper amount of water in the boiler by opening a gauge cock; that there is no accumulation of oil in the ash pan and fire box or existing leaks throughout; that fireman's regulating valve handle "J" is in extreme left position and oil valves "W" and "Y" are wide open. If in round-house, see that steam blower valve "G" is closed, then make steam or air connection at "A" in cab. If oil in tank is too cool to readily flow to burner it must be heated. Open valve "D" and blow steam through burner, at the same time opening damper "L" and blower valve "H" enough to create a slight draft at the stack; close valve "D" while placing a piece of ignited oily waste through the open fire door in front of burner; closing fire door, reopen valve "D" then move handle "J" of fireman's valve to the right sufficiently to allow some oil to be blown from the burner above the blazing waste and watch the ignition through hole in the fire door. Regulate steam and oil supplies to suit. Be sure no oil is wasting below the burner or an explosion may result.

115. Explain the proper use of the damper?

Ans. It must be regulated to suit conditions. With fire extinguished or engine drifting, damper should be closed.

116. Explain the proper use of the blower.

Ans. On account of its destructiveness, blower must be used sparingly, and as little as consistent to meet requirements, when throttle is closed.

117. Under what conditions may an employe enter an oil tank for cleaning the strainer, etc.?

Ans. After tank has been thoroughly drained, steamed and washed out with cold water.

118. What causes smoke, and how may it be prevented?

Ans. By burner being out of adjustment, faulty construction of brick-work or improper method of handling. An accurate location of the burner and close regulation of steam, oil and air, and proper condition of other accessories will prevent same.

119. What is the effect of supplying too much oil?

Ans. It is destructive to fire box and flues, causes black smoke and oil is liable to waste below burner.

120. Why should oil not be allowed to drip from burner to ash pan?

Ans. It is liable to cause an explosion.

121. Why should leaks not exist in oil appliances?

Ans. It would be waste of oil, and is also dangerous.

122. What should be the condition of the fire and water level in boiler when starting a train, and why?

Ans. The fire must be so regulated that the maximum steam pressure will be maintained. Water level should be uniformly high, but not sufficient to work over into valves and cylinders.

123. What is the objection to carbon or slag on tip of burner or face of flash-wall in fire box?

Ans. Black smoke may ensue and poor steaming result.

124. When and how is the oil in tanks heated, and what is the maximum degree allowed?

Ans. When the oil will not flow freely from tank to burner, to heat oil open steam valve "C" and regulate to supply sufficient pressure to coil "R"; the maximum is 112 degrees.

125. What is the purpose of the extra heater on the engine?

Ans. Simply to aid in giving the oil additional heat when desired.

126. Explain how to operate the heaters.

Ans. Open cock on boiler head just sufficient to produce steam-water at drain cock under tank. Heater should be used constantly when weather is chilly. Keep drain cock to super-heater open just sufficient to keep cylinder dry.

127. Who is responsible for the performance of the locomotive enroute?

Ans. The engineer.

128. Must fireman obey the instructions of engineman as long as they do not conflict with the Company's rules?

Ans. Yes.

SECOND YEAR EXAMINATION.

135. What are an engineman's duties prior to taking out an engine for a trip?

Ans. He should ascertain work that was previously reported, that there is sufficient water in the boiler by opening a gauge cock; see that the engine is in good working order and furnished with necessary tools and supplies.

136. What are the engineman's duties at the end of a trip?

Ans. He must leave the boiler filled with water to the maximum level, after thorough inspection report in writing the necessary work to be done on engine.

137. What supplies are consumed on a locomotive each trip?

Ans. Coal, oil, water and sand.

138. What tools constitute a locomotive equipment?

Ans. Tools that are designated for different classes of engines that would enable engineman to disconnect and care for engine out on the road.

139. What tools are assigned to the personal use of the engineman?

Ans. (Note the requirements.)

140. How does steam travel from dome, through cylinders to stack?

Ans. When throttle valve is open it enters

stand pipe, dry pipe, passes through to nigger-head, to steam pipes, to steam passages, to the steam chests. When either steam port leading to the cylinders is uncovered by the valve steam enters the cylinders and escapes from the cylinders through the same port which it entered, through the exhaust passages in the cylinder saddle, to exhaust pipe and nozzle through the petticoat pipe and stack to the atmosphere.

141. How is the power of the steam transmitted from pistons to drawbar?

Ans. Steam transmits power to the drawbar by the pressure exerted on the piston, piston-rod, cross head, main rod and crank pin in driving wheels on axle, on driving box to frame to which draw-bar is indirectly attached.

142. What is the purpose of safety valves on cylinder heads, and to what pressure must they be adjusted?

Ans. To relieve cylinder of over-pressure from any cause; should be set twenty pounds in excess of working pressure.

143. What may you do for repairs to a broken spring in a safety valve enroute?

Ans. Screw down on the adjusting screw until steam ceases to escape.

144. How will you know when a dry pipe is leaking?

Ans. By the action of the engine. To test, fill boiler with water to a height that would submerge dry pipe. If steam and water comes out of cylinder cocks dry pipe is leaking.

145. Explain the principle on which an injector works.

Ans. It works upon the principle of induced currents. Steam enters the injector at a high temperature and with great velocity. Coming in contact with cold water condenses the steam and absorbs the heat. A part of its velocity is imparted to the water, giving it sufficient energy to force the check valve open and enter the boiler against high pressure.

146. How may you prevent an injector, hose and branch pipe freezing enroute?

Ans. Close overflow valve, open water valve and steam valve, regulate steam supply at fountain, open frost valve on branch pipe near check valve.

147. Describe the common causes of injectors failing and the remedies to apply for such failures enroute.

Ans. Feed pipe stopped up, leak in feed pipe, water in feed pipe too hot, boiler check shut or open, tank valve disconnected.

If water too hot or tank valve disconnected close overflow valve and blow steam back into tank. This will remove obstruction and feed hose fills with fresh water from tank. If boiler check stuck shut or open it sometimes can be moved by tapping lightly on the valve casing.

For leaky feed pipe, remedy is obvious.

148. Where are the strainers located and how can you clean them?

Ans. Located in feed pipe, some engines have an extra strainer in feed pipe; to clean, take down hose.

149. What should be done when both injectors fail enroute?

Ans. Extinguish fire and notify proper officer.

150. How may you prevent the loss of water from boiler when check valves stick open?

Ans. Close overflow valve, and water regulating valve (if there is one) and water ram, which will prevent water from passing through injector, until can get check down.

151. How would you proceed to fill a dead boiler enroute, having plenty of water in tank and a live locomotive at your disposal?

Ans. Open injector throttle, tank valves and water ram, place lever in direction you wish to go, open engine throttle, wrap relief valves to prevent intake of air, have live engine move you. The pistons will pump air out of boiler and atmospheric pressure will force water from tank into boiler.

152. Explain the construction of the blow-off cocks on boilers, and how they are to be used to get rid of water, advantageously, when standing.

Ans. There are many kinds of blow-off cocks, the simplest is the plug valve which is opened by hand; the pneumatic blow-off cock has a piston on which the steam or air pressure acts to open the valve when standing, mud and scale will settle to the bottom, to use, open blow-off for a few seconds, then close a few seconds; do not reduce pressure to exceed ten pounds.

153. Explain the construction and operation of a sight feed lubricator.

Ans. A sight feed lubricator consists of oil reservoirs with its filling and drawing plugs located respectively at top and bottom of oil reservoir; oil feed pipes and sight feed glasses;

indicator glass to oil reservoir; condensing chamber above oil reservoir, and supplied with steam by pipe connection to globe valve at fountain; a valve called water valve to shut off communication between condensing chamber and oil reservoir and feed valves located at bottom of sight feed glasses.

There are pipes used to convey the oil from top of sight feed glasses. To operate, fill with oil, with oil valves closed; then open steam valves and water valves; regulate feed with feed valves.

154. Explain in what order the valves should be opened or closed for filling, starting or stopping a lubricator.

Ans. For filling, close oil feeds, steam valve and water valve. For starting, open steam valve; then water valve; open feeds when desired.

155. How will you get oil to cylinders when lubricator fails?

Ans. When drifting shut off open oil cups attached to oil pipes just over sight feed glasses and pour in the oil. The vacuum in cylinders will draw the oil through pipes to cylinders, or oil through relief valves.

156. How may you blow out a lubricator that fails to work? (a) How may you blow out a choked sight feed of a lubricator?

Ans. Close all valves, drain oil out of lubricator, open steam and water valves, open drain plug and sight feeds. This will blow steam through, removing dirt. (a) If sight feed becomes choked up, close water valve leaving feed valve well open on glass to be cleaned; open drain plug, when water and

sediment in the glass will be drawn into body of lubricator.

157. How many drops of valve oil per minute should be fed to different sizes of cylinders, including the air pump?

Ans. Would depend upon work required and condition of engine and boiler; good or bad water, for air pumps, 1 to 2 drops per minute.

158. Why do lubricators feed faster at different times?

Ans. Too much cold air striking lubricator will affect its feeding; equalizing tubes partially stopped up, or choke plugs worn too large.

159. Explain how the weight of our Pacific (4-6-2) type of engines is supported above the journal boxes.

Ans. Spring resting upon saddle over top rail of frame connected by spring hanger to equalizer upon which the frame rests.

160. How should sand be used when engine is slipping?

Ans. Sand should not be applied while engine is slipping.

161. How would you run an engine and lubricate a moving piston on a disabled side?

Ans. Take out water valve or indicator plug and oil through opening. Engines not having water valves or indicator plugs loosen cylinder head sufficient to admit oil.

162. Name all the parts of a Stephenson valve motion.

Ans. Eccentrics, eccentric straps, eccentric rods, link, upper and lower rocker arm, valve rod, link-hanger, reverse shaft arm, tumbling

shaft and vertical arm, reach rod, reverse lever, quadrant and counter balance spring.

163. What is the duty of each pair of eccentrics?

Ans. To give the valves their motion or a reciprocating movement.

164. How are eccentrics secured on axles?

Ans. By set screws and keys.

165. How may you set a slipped eccentric?

Ans. There are several quick methods of setting eccentrics. When time is considered, a good way is to move the eccentric until its web or spoke forms an angle with the main pin as nearly equal to that of the other eccentric as it is possible to judge, secure the eccentric in this position and get away.

166. How is a plain D-slide valve balanced?

Ans. By placing strips on back of valve in suitable grooves and securing a balanced plate to the under side of the steam chest cover that the strips would come in contact with and form nearly a steam-tight joint, preventing the steam chest pressure from exerting any pressure downward on the back of the valve. A hole is drilled in the back of the valve. Any steam leaking by the strips will pass to exhaust.

167. How is a piston valve constructed?

Ans. The piston valve derives its name from its form being piston shape and connected together by a stem. There are two packing rings fitted in each end. The exhaust, branches and communicates with the end of the steam chest. This type of valve is known as an internal admission or indirect valve.

168. How can you detect a valve running dry or cutting?

Ans. By action on reverse lever when cutting there will usually be a groaning of cylinder.

169. What pressure is on the stems of piston valves on our simple engines?

Ans. Whatever back pressure there may be due to exhaust steam escaping through nozzle tip.

170. How will you locate a "blow" in a slide valve?

Ans. Place engine on quarter on side to be tested, cover ports, open cylinder cock and open throttle with brake set. If steam comes out of one or both cylinder cocks on that side it would indicate valve was blowing.

171. How will you locate a "blow" in a piston valve?

Ans. Place valve in mid position to cover ports, set brake and open throttle, open cylinder cocks and note if there is flow of steam.

172. What is meant by giving a valve "lead"?

Ans. "Lead" is the amount of port opening of the valve when the piston is at the beginning of its stroke.

173. How does the "lead" vary on the Stephenson motion?

Ans. Increases as reverse lever is moved towards center notch.

174. What is meant by the term "cut-off"?

Ans. The point of the stroke at which the port is closed.

175. What are the advantages of using steam expansively?

Ans. Economy. Just how far to expand the steam, however, is the point that must be considered and decided by the engineer. In determining the position in which reverse lever and throttle must be carried the engineer must take into consideration speed and weight of train, profile of road and steam quotations.

176. What is the purpose of the link?

Ans. The purpose of the link is two-fold. 1st, it provides a means of readily reversing the engine. By means of it the rocker can be quickly thrown under control of one or the other of the eccentrics; 2d, it provides a means whereby the admission of steam to the cylinders can be readily cut off at different parts of the stroke.

177. What is the difference between the Stephenson and Walschaert valve gears?

Ans. The Walschaert valve differs from the Stephenson link motion in that it requires for each cylinder but one eccentric or its equivalent to insure the movement of the valve. The eccentric is secured to the axle either directly or by a return crank from one of the crank pins. There is a combining lever attached to the cross-head and radius rod which gives the valve a movement equal to its lap and lead.

178. From what two points does a valve receive motion in the Walschaert gear?

Ans. From the eccentric and combining lever, connected to cross-head.

179. What moves the valve in the Walschaert gear when lever is run in the center notch?

Ans. The combining lever and connecting link attached to cross-head.

185. Explain how to disconnect and use steam on both sides with Walschaert gear when either an eccentric crank, eccentric rod, bottom link arm, or one of the two link trunions is broken.

Ans. Disconnect eccentric rod, also radius rod from hanger, block same in center of link. Now the combining lever and connecting link attached to cross-head will give the valve its movement, sufficient perhaps, to move engine off center.

186. Explain how to disconnect Walschaert gear for clamping valve centrally for operating on one side.

Ans. 1st, disconnect combining lever connecting link at main cross-head. 2d, shift valve stem to desired position for clamping. 3rd, remove eccentric pin out of crank arm and swing its rod to running board. 4th, tie combining lever and connecting link ahead sufficiently for clearing main cross-head movement.

187. After disconnecting a main rod, where and how must the cross-head be blocked on the respective classes of engines?

Ans. At the back end of guides except on engines where cross-head will not clear, block at front end of guides even with travel mark, block in front of cross-head using clamps or blocks binding with wire or bell cord.

188. How can a "blow" in cylinder packing rings be located?

Ans. Place the side of the engine to be tested on the top quarter, block wheels, open

cylinder cocks, place reverse lever in forward corner, open throttle. If steam blows through back cylinder cocks as well as the front one it indicates cylinder packing blowing.

189. How would you locate a bad "pound" in an engine?

Ans. When you have determined which side of engine "pound" is on, place crank pin on that side on top quarter, block wheels, give engine a little steam, reversing engine suddenly a few times, while you watch all points on that side.

190. How would you set up a wedge? (a) How can a wedge be kept in position when its bolt is broken?

Ans. Engine should have up steam standing on straight track; set engine on top quarter on that side, cut out driver brake, set tank brake, place lever in forward motion, give engine just enough steam to force driving box up against the shoe, proceed to set up wedge. (a) By fastening a nut or piece of iron between pedestal and wedge.

191. How would you work an engine on heavy train and bad rail.

Ans. Would use as light a throttle as possible and increase travel of valve. Engine would be less liable to slip.

192. In what position should reverse lever be for different speeds when drifting?

Ans. At a high rate of speed, lever should be kept near center notch. It can be lowered according as speed decreases.

193. What is the danger from using sand on but one side? (a) Or catching a slipping engine on sand?

Ans. The strain of both engines is thrown on one side. (a) Sudden catching of wheels on sand is liable to result in a loss of a crank pin or other damage, besides subjecting engine to an unnecessary strain.

194. What would you do for a hot driving box enroute? (a) Crank pin? (b) Truck journal?

Ans. First, see if it had been getting the oil intended for it. If not too hot, a good plan is to raise the waste on top of box and pour on a couple quarts of water; then an oiling of valve oil will often times bring it down. When wedges are up taut it is a good plan to slack off on same. When supplied with water pipes, often times a small stream of water run between hub and box or on journal next to inside of box will get engine to terminal. In extreme cases pull waste off top of box and run water on top. (a) Keep grease well screwed down, slack off on key if necessary. (b) Examine cellar packing, repack if necessary. If heat due to broken brass arrange to renew it.

195. Would you reverse engine with drive brakes applied?

Ans. No.

196. How may you get sliding driving wheels to again revolve without releasing train brakes?

Ans. By the use of the hand release in cab. If conditions will permit give engine steam at the same time.

197. What would you do if both water tank valves should become disconnected while closed enroute?

Ans. Close overflow valve, open injector throttle and try to blow the valve out.

198. What are your several duties before going into the details of disconnecting a disabled engine?

Ans. See that train is properly protected. If possible, notify the proper officers of conditions.

199. How will you proceed to locate a broken valve stem in chest and prepare to proceed on one side?

Ans. Beginning on, say the right side, place main pin on quarter, open cylinder cocks admitting a little steam to cylinders, then move reverse lever from one corner to the other. If steam does not show at the same point of cut-off in both motions the trouble is on that side. When there is relief valve in front put a plug in same of sufficient length to hold valve over port. This will hold valve from coming forward. Disconnect valve stem at rocker arm, push it up against valve and clamp it; remove relief valves in cylinders and run with main rod up on heavy power. With engines not having relief valves so located, disconnect and shove valve ahead, disconnect main rod, and block cross-head accordingly, as steam will now pass through open port to cylinder.

200. How would you disconnect and block in case of a broken go-ahead eccentric, rod or strap?

Ans. When but short distance from destination; remove broken strap and rod; clamp valve in mid position, leave main rod up; take off link hanger and allow link to ride on the

link block. If distance is too great it is best to take down both eccentric straps and rods and proceed on one side.

201. If back motion parts are broken?

Ans. Remove broken parts, secure a block of wood in link slot between bottom of link block and bottom of link; fasten the bottom of the link both forward and back so it cannot swing back and forth. Engine can now be run ahead with reverse lever in corner. If distance is too great disconnect both straps and proceed on one side.

202. If link-hanger, saddle pin or tumbling shaft is broken?

Ans. Remove broken parts; raise links to such position as will enable engine to handle train; next measure the distance between top of the link block and top of link slot; cut a block of that length that will fit into the slot on top of the link block on the broken side, also a block between link block and bottom of link, allowing enough space between the blocks for the slip of the link on the block.

203. If reach rod is broken?

Ans. Proceed same as in answer 202.

204. If link block pin is broken?

Ans. Disconnect valve stem, clamp to cover ports, secure bottom rocker arm to clear movement of link, run main rod usual way.

205. If bottom rocker arm is broken?

Ans. Remove broken parts, note that blade pin does not travel too close to any part of rocker still remaining. The link may be left up. Disconnect the usual way.

206. If intermediate arm is broken between rocker arm and link block?

Ans. Take intermediate arm down, disconnect and calmp valve, run main rod usual way.

207. If bridge in valve seat is broken?

Ans. Disconnect valve stem, clamp valve to cover ports, run main rod usual way.

208. If piston rod is broken?

Ans. When piston breaks it almost invariably causes front cylinder head to be knocked out. If piston breaks close to cylinder head and is not bent or damaged, all that is necessary to do is to disconnect valve and clamp in mid position. If rod is broken at some other point, knock out key; disconnecting it from cross-head, remove broken parts, run main rod usual way.

209. If valve stem or top rocker arm is broken?

Ans. Remove broken parts, disconnect and clamp valve to cover ports, run main rod usual way.

210. If piston or cylinder head is broken?

Ans. If piston or front cylinder head is broken, disconnect valve to cover ports, run with main rod up. If back head, it would no doubt affect the guides; if so disconnect main rod also.

211. If guides or cross-head broken?

Ans. Disconnect valve and clamp to cover ports, disconnect main rod. It may be necessary to block cross-head at front end of guides.

212. If main rod or its strap is broken?

Ans. Disconnect valve and clamp to cover ports, take down main rod, fasten block on pin to hold side rod in position.

213. If key is lost out of main rod?

Ans. Insert a piece of iron as near the proper size as is possible to obtain, drive in taut. This will hold until arrangements can be made for a better one.

214. If side rod broken on two pairs of driving wheels? (a) Three pairs? (a) Four pairs?

Ans. If front side rods are broken on consolidation engine take them down. If back rods, take them down. If on both front pair and one back, take down the broken rods and the one directly opposite. If side rods between main and number two drivers are broken take down all side rods, disconnect and clamp both valves; run main rods up and tow engine in. If ten-wheel or Mogul or an engine with eccentrics connected to main shaft, take down broken side rods and the one opposite. You can proceed with just main rods up. Always take down opposite side rod.

215. If main rod crank pin broken?

Ans. With engine having eccentrics on other than main shaft take down all rods, disconnect and clamp valve, block cross-heads and be towed, except if but short distance to clear main line, it might be permissible to leave rods up on good side and run engine light, using throttle very carefully; if eccentrics on main shaft, take down all rods except main rod on good side, run carefully.

216. If main driving wheel axle broken?

Ans. In this case just how much damage will be done cannot be determined. If no other damage is done and engine is one of our consolidation type, remove all side rods

and main rods, clamp valves in mid position, remove broken wheel if possible; if not, swing both main wheels from the rail. To do this raise the driver until the box is at the top of the jaws and block below the box and the pedestal brace in order to carry the wheel off the rail. Block under ends of springs and on top of lower rail of frame to relieve the box of the weight it carried. Knock out saddle pins and remove saddles; chain wheels to frames. If time is an object, eccentrics being on number two shaft they can be left up and engine towed in carefully to avoid further damage. If eccentrics are on main shaft axle, broken next to hub, proceed as with broken crank pin.

217. If driving wheel spring or hanger broken?

Ans. If on eight-wheel engine, run main driver upon a wedge so as to relieve the back spring, pry up front end of the equalizer until it is level and block it there; then run main driver off the wedge and run back driver upon a wedge and put a block on top of main box under frame; run engine off wedge and slacken off on driving box wedge a little to prevent sticking. Oil this box freely. On other class of engines block with a view to getting the use of the remaining springs.

218. If equalizer between driving wheels broken?

Ans. Run back driver up on a wedge and block on top of main driving box; run back driver off and front driver up on a wedge and block on top of back driving box; remove broken parts, also springs if necessary.

219. If enigne truck spring or hanger broken? (a) Tender spring broken?

Ans. In many cases engine will run to terminal; if not raise front end of engine, pry up frame on broken side and block between the equalizer and truck frame close to the spring band, keeping it up level with the other side. If a Mogul truck, block between the top of the truck box and the truck. (a) If there were but one spring remove broken parts and block between tank and truck.

220. If long equalizer between pony truck and first drivers broken?

Ans. It will depend on the position of the break. On some engines the fulcrum is constructed with two holes through the equalizer for the purpose of changing the weight on the truck wheels. In case this equalizer breaks forward of the fulcrum bearing remove broken piece. Then place blocks on top of the pony truck frame directly under the frame of the engine; run pony truck up on wedges so as to raise the engine frame with respect to the front driving boxes; pry the back end of the equalizer down until it is possible to put another pin through the extra hole in equalizer fulcrum casting, then run the truck wheels off the wedge. Another plan is to raise the front end of the engine frames and pry the front ends of the front driving springs down to position and chain the cross equalizer to position by chaining around the engine frames. This plan could be adopted where brake is back of the fulcrum bearing.

221. If front engine truck wheel or axle broken? (a) Rear truck wheel or axle?

Ans. It might be advisable to block and slide wheel; if not, jack up the front of the engine high enough to take the weight off the truck, raise the truck frame and the box with broken axle parallel to the one on opposite side and put a block under the journal box on the stay plate or pedestal that is thick enough to hold the box in that position; chain the truck in position by means of a chain wound around the main frame and stay plate; fasten another chain to the corner of the truck frame nearest the broken axle and the engine frame on the opposite side of the engine to prevent the end of the trucks from swinging far enough to allow the wheel to drop off the rail. A block should then be placed between the top end of the equalizer on the disabled side and the engine frame. (a) If back axle breaks, chain and block in a similar manner.

222. If front section of frame broken? (a) Back section?

Ans. Report broken frame at once and give up train. (a) If top rail breaks at any point, would give up train. Discretion should be used; disconnect or not as judgment dictates.

223. If driving wheel tire broken?

Ans. If on main wheel and if it is a bad crack, or even if broken through, if the tire is still on the wheel, have some one watch it while you run slow and try to reach the nearest siding. If tire is loose enough, remove the tire, taking off the rods, disconnect on broken side and remove side rods; place a jack under the axle and raise the broken tire, remove the oil cellar and fit a hard-wood block between the axle and the pedestal; block under the spring to relieve box of its weight. Now re-

move the jack from under the axle and raise the engine on the broken side and block between the top of the driving box and the frame of the box, or boxes next to the main wheel on that side. Now let the engine down, and if the wheel clears the rail, proceed slowly; if not, block a little higher. If tire cannot be removed and it will not let wheel revolve, disconnect on both sides and prepare to be towed in. Block up the main pair of wheels high enough to clear rail on both sides.

224. If tender wheel or axle broken?

Ans. It might be advisable to block and slide the wheel, if not you can find a piece of rail the right length or a cross-tie will answer, place it across the top of the tank directly over the broken pair of wheels; block under the rail or tie, to protect the flange on top of tender; jack up broken pair of wheels to clear the rail. While in this position chain the truck to the rail or tie above the tank on both sides.

225. If trailing wheel or axle broken?

Ans. It is necessary to swing that wheel and carry it clear of the rail. Since main drivers are so far forward, some means must be provided to prevent back end of engine from settling. Run the trailer up on a wedge until slightly higher than its normal position; remove the oil cellar and fit a block between bottom of trailer box and pedestal; fit a block in place of the oil cellar so as to carry the wheel in its raised position. Next relieve the box of the weight it carries by putting a strong chain around the end of the cross equalizer and chain up to frame, or block below cross equalizer in safety hanger. When

trailer is carried off the rail the overhanging weight throws considerable strain upon driving spring. To protect this spring, block between top of driving box and frame. Still another way is to block on top of front end of equalizer directly under frame; take a tie or piece of iron, place it as far back in deck of cab as possible, allowing it to extend over on deck of tank a short distance; pass a chain around the rail piece of engine and around tie or iron after raising back corner of engine slightly higher than its normal position; hook chain as tightly as possible and wedge between tie and chain to take up slack in chain.

226. What would you do if throttle valve stuck open enroute? (a) If stuck closed?

Ans. A throttle stuck open makes an engine rather dangerous to handle. Reduce steam pressure so engine can be handled by means of the brakes and reverse lever. When making a stop move reverse lever to center notch *and apply brakes.*. Notify Dispatcher of conditions. (a) Prepare to be towed in.

227. How would you finish trip if reverse lever was caught at short cut-off by a spring?

Ans. By disconnecting front end of reach rod or lifting arms from link hangers; block up links in such position as will handle the train.

228. What purpose have the air-inlet valves on steam chests?

Ans. To overcome vacuum that would be formed in cylinders drawing hot gases and cinders into steam chest.

229. What would you do if you lost an air-inlet valve?

Ans. Screw off top of valve casing and fit in a block of wood; except Eng's 1556 to 1587, 1701 to 1783, 1901 to 1930 and 2100 class; would remove relief valve and insert a two inch (pipe) plug.

230. If steam heat regulator should stick closed, how would you get steam to train?

Ans. Remove bottom hex-nut cap and take out the main steam valve and its spring, then replace cap and control pressure by boiler valve remainder of the trip, when it must be reported. But, if it is a Mason style remove bottom nut cap, but instead of taking out steam valve, block about one-fourth inch between the valve and its piston.

231. What is the greatest steam heat pressure to be given in a 6-car train? (a) A 10 car train?

Ans. 60 pounds maximum. (a) 95 pounds maximum.

232. How does the steam travel from dome, through cylinders to stack of a Baldwin balance compound?

Ans. Steam passes through the dry pipe, through steam pipes to steam port which is centrally located between the induction ports of the high pressure cylinders. Steam enters the high pressure cylinder through the steam port and the central external cavity in the valve. The exhaust from the high pressure cylinders takes place through the opposite steam port to the interior of the valve, which acts as a receiver. The outer edges of the valve control the admission of steam to the

low pressure cylinder. The steam passes from the front of the high pressure cylinder through the valve to the front of the low pressure cylinder, or from the back of the high pressure cylinder to the back of the low pressure cylinder. The exhaust from the low pressure cylinder takes place through the external *cavities* under the front and back portion of the valve which communicates with the final exhaust port. The starting valve controls the two live steam ports of the high pressure cylinder to allow the steam to pass over the piston.

233. How should a compound engine be started with a train?

Ans. Always open the cylinder cocks to relieve cylinders of condensation; except in case the engine is attached to a passenger train at a crowded station or in some position when it is undesirable to open cylinder cocks. Open starting valve to admit steam to low pressure cylinder. After a few revolutions have been made the starting valve should be closed.

234. How would you disconnect and proceed with a broken valve stem with a Baldwin balance compound engine?

Ans. Clamp valve in mid position to cover ports; take out water valves on cylinder head, leaving main rod up same as on simple engine. If no water valves, open up the cylinder heads sufficient to admit oil and proceed on one side.

235. What should be done for a loose piston rod in cross-head?

Ans. Tighten the key. If unable to do this account badly worn or broken key, re-

move same and drive a piece of iron in, making as good a fit as possible.

236. How fast may a disconnected engine be run without injury to track?

Ans. It would depend upon conditions, class of engine, etc.; it would be a matter of good judgment upon the part of the engineer, except where the rules limit the speed.

ELECTRIC HEADLIGHT.

237. What constitutes a complete electric headlight?

Ans. Engine dynamo, lamp and material.

238. What kind of oil should be used on the different bearings? (a) Should the commutator be lubricated?

Ans. Valve oil should be used on outside bearings. Remove plug in top of engine once each week and pour in a little black oil. (a) No.

239. What may result if brushes bear too hard on commutator? (a) Too light?

Ans. It creates friction heat and unnecessary wear. (a) It will spark and commutator will not run clean.

240. What will be the result if scale is allowed to collect on copper electrode?

Ans. It prevents the generation of light.

241. How should the tension spring be regulated on the carbon holder?

Ans. It should be so adjusted that when locomotive is running the light will be steady, but flicker a little when standing. The looser the spring is adjusted the better and a greater volume of light will result.

242. How may you apply a carbon stick? (a) About how many hours will one run?

Ans. Remove upper holder, drop bottom end of carbon stick through tension spring

and replace upper holder. After putting in a new carbon always push down on lever No. 90 and notice that the carbon lifts and falls freely. If carbon does not lift it is not in the clutch. If carbon does not fall down freely turn it partly around and find the freest place. (a) From eight to nine hours.

243. About how many revolutions per minute should the dynamo and engine run?

Ans. About eighteen hundred revolutions per minute, unless the copper electrode burns off, when it should be reduced until the copper electrode does not burn.

244. If, when starting a dynamo and when up to the proper speed, the lamp should fail to illuminate, where would you look for the trouble? (a) If light goes out?

Ans. See that tension is not adjusted too taut, and that electrode is free from scale. (a) Tension spring may be adjusted too loose, or carbon may not feed freely.

245. What is the general cause of fast consumption of copper electrode, the light burning green, and what would you do in such cases?

Ans. Excessive speed. Throttle should be used to regulate speed when governor fails.

246. What troubles are determined by placing a carbon stick across the two binding posts of the dynamo? (a) Across the two binding posts on the lamp?

Ans. If there is a flash when removed the dynamo is all right. If there is no flash when carbon is removed, commutator needs cleaning with sandpaper. (a) Wires broken or screws loose.

247. What may be the damages to dynamo if run after lamp refuses to burn?

Ans. Dynamo will heat and burn out.

248. What may be the damages to a lamp if allowed to burn green?

Ans. Will burn and melt the copper electrode.

249. How often and with what kind of oil should the steam turbine be lubricated?

Ans. Once a week with engine oil.

THIRD YEAR EXAMINATION.

AIR BRAKE AND SIGNAL QUESTIONS

253. Names the principal parts of the steam valve motion of a Westinghouse 9 ½ inch pump.

Ans. Main slide valve, differential pistons and connecting rod, reverse slide valve and reversing rod.

254. Name the principal parts of the valve motion of a New York No. 6 pump.

Ans. There are two steam cylinders, and in the head of each cylinder is located a reversing valve, each one attached to a reversing rod which extends into the piston rod.

255. What moves the slide valves in New York pumps?

Ans. As the pistons move up and down in the cylinders, just as they are about to complete their stroke, they alternately pull and push the reversing rods, and these in turn move the slide valve attached to their lower end.

256. Explain the flow of steam from boiler to stack when a Westinghouse 9 ½ inch pump is running.

Ans. As steam enters pump it enters the main valve chamber between pistons 77 and 79. Since the area of piston 77 is greater than

piston 79, it is forced to the right, drawing with it piston 79 and slide valve 83, which causes the slide valve to uncover a port in the seat so that the steam can pass from the main valve to chamber down through a passage in the side of the cylinder to the underside of the main piston, which forces it up, and the reversing plate strikes shoulder "J" on the reversing valve stem, which drives the reversing valve up and allows steam in reversing valve chamber to pass through the lower horizontal port in the main valve bushing into chamber between the head 84 and piston 77. As this balances the pressure on both sides of the large piston 77, the small piston 79 now pulls the slide valve to the opposite end of the chamber which uncovers the supply port to the top of the main piston and allows the steam to force it down, and, at the same time, the steam from the under side is being exhausted by way of the cavity in the slide valve which now has the lower supply port and the main exhaust connected. There is a small port between the plain side of piston 79 and the head 85 which is always open to main exhaust, so that no back pressure can remain or partial vacuum be formed on that side of the small piston. The main valve chamber is always in communication with the reversing valve chamber by a small port in bushing 75. Cap nut 74 has a small port in it which allows live steam to always reach the top of the reversing valve steam for the purpose of keeping the pressure balanced on both ends of it.

257. Explain the flow of air through a Westinghouse 9 ½ inch pump to the main reservoir.

Ans. As the piston is raised, the air above it is compressed and as soon as the pressure below the discharge valve becomes greater than main reservoir pressure, discharge valve raises and air is forced into chamber "G," thence into main reservoir. The upward movement of the piston produces a suction which causes lower receiving valve to lift from its seat. And atmospheric air enters through strainer through receiving valve to cylinder. On the downward stroke the effect just described is produced upon the opposite corresponding receiving and discharge valve.

258. Explain the flow of steam through a New York No. 6 pump.

Ans. When starting steam enters the chambers "A" and "B," steam passages 23 and 26 are open for admission of steam, but only piston 21 will move upwards. The steam then enters cylinder 4, simply acting to hold piston 22 down. When piston 21 completes its stroke, it will shift slide valve 6 to its upper position and steam will then enter cylinder 4 through port 27 and underneath piston 22, moving it upward. The live steam already in cylinder 4 above piston 22 will then exhaust through ports 23 and the pump will proceed to work in the manner described.

259. Explain the flow of air through a New York No. 6 pump to the main reservoir.

Ans. As the low pressure piston starts on its upward stroke, a partial vacuum is created on under side of it and atmospheric pressure forces the bottom receiving valve up, filling low pressure cylinder with atmospheric pressure, and as the piston does not move again until the piston in the high pressure cylinder makes

its stroke upward, creating a partial vacuum, the bottom receiving valve and also the bottom intermediate valve are forced off their seats, and when the atmosphere has equalized in both cylinders, then both valves drop to their seats. As the low pressure piston starts down, the lower intermediate valve is forced from its seat and air in low pressure cylinder is forced into high pressure cylinder which was previously charged with air. While the low pressure piston is moving down, the top receiving valve is forced from its seat by atmospheric pressure rushing into cylinder. As the high pressure piston starts down, a partial vacuum is formed in cylinder and atmospheric pressure forces top receiving and top intermediate valve from their seats. When pressure in both cylinders have equalized both valves drop to their seats and at the same time the air contained in lower end of high pressure cylinder is being discharged through bottom discharge valve into main drum.

260. What is the greatest number of strokes per minute each piston in an air pump should be permitted to run enroute?

Ans. Never exceed one hundred and fifty strokes.

261. What are the indications when a piston makes one stroke quicker than the other?

Ans. One of the air valves "blowing" or is stuck or broken.

262. What causes air pumps to overheat and burn out?

Ans. Bad packing rings and air pistons; too little lift of air valves or valve stuck; the ports and passages gummed or clogged due to excessive use of poor oil in air cylinders.

263. How much valve oil should be fed the steam cylinders of an air pump per minute?

Ans. One to two drops per minute.

264. Where should the air cylinders be oiled, and with what kind of oil?

Ans. New York pump, through automatic oil cups, with valve oil. Westinghouse pump, through pet-cock on top of air cylinder, with valve oil.

265. How would you oil steam cylinders of air pumps, should lubricator in cab fail enroute?

Ans. Westinghouse pump, shut off throttle, remove reversing cap. New York pump, shut off throttle and disconnect steam pipe at union.

266. How should air pumps be started?

Ans. Open drain-cock, open throttle and run pump slowly until 30 pounds pressure has accumulated in main reservoir.

267. How many air valves in a New York No. 6 pump, and how may you clean them when on a siding? (a) In a 9½ inch pump?

Ans. Eight valves. Cut out train line under brake valve, shut off pump and drain air out of main drum. Begin by taking out intermediate valves, low pressure valves, then high pressure valves. (a) Four valves.

268. How will you inspect for loose nuts on end of piston rods of a pump?

Ans. Remove screw plug in bottom head. It is possible to feel with the fingers if nuts are taut and in place. If New York pump, take out automatic oil-cup and proceed as with Westinghouse.

269. How will you proceed to tighten loose nuts on end of piston rods of a pump?

Ans. Remove cylinder head on air end of pump.

270. What may an engineman do to start a stopped pump enroute?

Ans. Shut off throttle, jar steam chest a little, then turn on full steam pressure, see that steam passes through the governor and drip-cocks and it should be observed that oil supply is sufficient. Nuts on end of main piston, steam valves and valve gear examined and that pipes and strainers are not choked or frozen.

271. To whom must engineman report by wire when the air pump completely fails enroute, and why?

Ans. Division Superintendent and Chief Dispatcher, to obtain instructions for locomotive and train for the remainder of the trip.

272. What must be done when a pump fails on head engine of a double header enroute?

Ans. Brakes must be operated by second engine and engines switched at first opportunity if the class will permit:

273. What is the purpose of the main reservoirs?

Ans. To re-charge the auxiliary reservoirs to carry a pressure in excess of the train line pressure to readily release the brakes.

274. What is the greatest pressure allowed in main reservoirs?

Ans. 120 pounds.

275. What is the standard pressure allowed to be carried on the train pipe and auxiliary reservoirs?

Ans. 70 pounds.

276. Explain the construction of the pump governor.

Ans. There is a duplex and ordinary kind in use. The duplex has two tops containing the air valves and regulating springs. The ordinary kind has one top. There is a diaphragm valve, a heavy regulating spring bearing on top of diaphragm holding it down. The pin valve attached to the center of diaphragm closes port leading to top of air valve. The tension of spring being a little less than the air pressure desired. To regulate, remove cap-nut and turn screw bolt. The air valve which is attached to upper end of steam valve is held up in its cylinder by the pressure of steam in steam valve. There is a drip opening made through the body of the governor to prevent the accumulation of air and steam that might leak by the governor pistons.

277. When two air portions (duplex) are employed on governors, what pressure does each control?

Ans. One controls train line pressure and shuts off pump when brake handle is in full release position. The other controls main drum pressure when brake handle is in any other position.

278. When one air portion is employed on governors, what pressure does it control?

Ans. Main drum.

279. Explain how to readjust governors for controlling the proper air pressures.

Ans. Remove the cap, regulate by turning the screw plug.

280. What must be done for a governor when it is found that it will not allow steam to flow to the pump enroute?

Ans. Disconnect small air pipe union and plug it. Control pump with throttle.

281. What two pressures do the red and black hand on gauge represent?

Ans. Main drum and train line or auxiliary pressures.

282. What is the matter when the hands on the gauge do not stand together when handle of brake valve is in release position enroute?

Ans. Gauge out of order.

283. How should the hands on gauge stand when handle is in running position enroute?

Ans. The black hand should stand at train pipe pressure. The red hand should stand at main drum pressure.

284. What are the principal parts of a Westinghouse brake valve?

Ans. The body cover, the rotary valve and handle, equalizing discharge valve and feed valve attachment.

285. What are the principal parts of a New York brake valve.

Ans. Body cover, main slide valve which is connected by a link to a shaft operated by a handle; small cut-off slide valve which is controlled by an arm connected to the graduating piston.

286. Name the five positions for the handle of all automatic brake valves.

Ans. Full release, running position, lap, service and emergency.

287. What is the purpose of the running position?

Ans. To allow excess pressure to be carried in main reservoirs for promptly releasing brakes and recharging auxiliary reservoirs and keeping them charged.

288. Why must brakes not be released in running position with G-6 and B-1 valves?

Ans. Because it would not release all brakes promptly. Is injurious to equipment.

289. What is the purpose of the feed valve attachment on Westinghouse brake valves?

Ans. For the purpose of controlling the pressure in train pipe.

290. Will feed valve attachment supply leaks if auxiliary reservoirs have been charged above 70 pounds?

Ans. No.

291. How may you clean and readjust a controller or feed valve when standing?

Ans. Cut out train line under brake valve, place brake handle in emergency position and proceed. To adjust, take off cap and turn screw plug.

292. Explain how to clean the excess pressure valve attachment on New York brake valves.

Ans. Cut out train line under brake valve, let off main drum pressure, place brake handle in emergency position, take out excess pressure valve, clean with kerosene and wipe dry before replacing.

293. In what position must handle of brake valve be carried when brakes are operated by tail hose on rear of train?

Ans. Running position.

294. What is the purpose of the lap position on brake valve?

Ans. Lap position cuts off all air supply to train pipe, to be used when brakes are left applied and to preserve main reservoir pressure when train pipe suddenly loses its pressure, or otherwise when needed.

295. From where does the engineman first draw air from a Westinghouse valve to cause a service application of the brakes?

Ans. From chamber "D" and equalizing reservoir.

296. From where does the engineman draw air to cause an application of the brakes when using a New York brake valve?

Ans. From train pipe direct.

297. What machinery closes a train pipe discharge port following a service application?

Ans. When train pipe pressure is reduced slightly lower than that in the supplementary reservoir, that pressure forces the equalizing piston back, which causes the cut-off valve to gradually close port "F" and stop the train pressure from further exhausting.

298. Will the equalizing piston and valve close the emergency port at any time?

Ans. No.

299. In what position will you handle brake valve if no air will discharge in the service notches?

Ans. This would denote bad leak in train pipe. Move brake handles to service notch the same as though there was a train line exhaust.

300. What will be the action of a brake valve when applying brakes if an angle cock should become closed about half way back in a long train?

Ans. Train pipe exhaust would be shortened when applying brakes, and the brakes to the rear of this angle cock would not set except as train pipe pressure would be reduced by leaks which would undoubtedly happen in a short time.

301. What is the purpose of the reservoir attached to brake valves?

Ans. To increase the volume of air in chamber "D" which is needed to compensate for the volume in the train pipe.

302. What must be done when brake valve reservoir loses its pipe connection enroute?

Ans. Plug brass pipe union and train pipe discharge elbow on brake valve, and handle brake valve very carefully remainder of trip.

303. How and where are running tests of brakes to be made on passenger trains?

Ans. By a ten-pound continuous reduction, two hundred yards after leaving terminal or any point after change in make-up of train has been made and two miles before approaching a meeting point or any other place where an air brake failure might be disastrous.

304. How much pressure must be drawn off per gauge for all tests when standing?

Ans. A 20-pound continuous reduction.

305. How would you make an emergency stop?

Ans. Place brake valve handle in emergency position and leave it there until train comes to full stop with freight train, and until not less than five seconds of time have elapsed and the necessity for the application has passed on passenger train.

306. What is the least train pipe reduction that should first be made when applying the brakes and why?

Ans. Five pounds, so as to close leakage grooves; apply shoes to wheels and take up slack in draw bar.

307. How can brakes be graduated to any desired force?

Ans. After first reduction of five to nine pounds, lighter train pipe reductions can be made setting brake to any desired force.

308. At what train pipe reduction are brakes fully applied by a service application?

Ans. At twenty to twenty-five pounds.

309. Will brakes apply without a train pipe reduction, and why?

Ans. Yes. A leaky slide valve in triple, or a leak in rubber seated emergency valve. Especially if retainer is turned up.

310. Through what valves and pipes does air travel from main reservoir to auxiliary reservoirs?

Ans. Through brake valve, train pipe and triple valve to auxiliary.

311. What is the use of air in the auxiliary reservoirs?

Ans. For the purpose of setting the brake.

312. How much pressure does an auxiliary reservoir lose when the pressure in train pipe has been reduced 10 pounds?

Ans. It loses ten pounds.

313. About how quickly may an empty auxiliary reservoir be charged to 70 pounds?

Ans. 70 seconds.

314. What three duties does a triple valve perform? (a) Explain the operation of a quick acting triple valve.

Ans. Recharges auxiliary, sets and releases the brake. (a) A quick reduction in the train pipe pressure causes the piston to travel the full length of its cylinder, thereby bringing the removed corner of the slide valve over a port which permits the auxiliary reservoir pressure to pass down on top of the emergency piston, forcing it downward, which piston unseats the emergency valve, thereby forcing a direct opening to the brake cylinder from above the emergency check valve. There being practically no pressure in the cylinder and a comparatively high pressure in the train pipe, the latter pressure will unseat the check valve and pass into the cylinder until the cylinder pressure is about equal to the pressure remaining in the train pipe. The check valve will then seat itself. At the same time this movement is made, another but much smaller port is opened by the slide valve leading directly from the auxiliary to the cylinders, thus admitting auxiliary reservoir pressure to the cylinder.

315. Name both pressures bearing against a triple valve piston.

Ans. Auxiliary and train pipe pressures.

316. Does a Westinghouse triple valve piston travel half, or full stroke for a service application?

Ans. A half stroke.

317. What machinery stops a Westinghouse triple valve piston at half stroke?

Ans. Graduating spring.

318. What is the effect on the workings of a quick acting triple valve if its graduating spring is weak or broken?

Ans. Triple will go into emergency upon light reduction.

319. Must a triple valve piston be in the application, or release position to charge an auxiliary reservoir?

Ans. Release position.

320. What moves inside of a brake cylinder when air enters?

Ans. Brake piston.

321. What are brake pistons packed with to make them air-tight?

Ans. Leather.

322. What is the full stroke of car and tender brake piston?

Ans. Twelve inches.

323. What is the least travel to which tender and car pistons should be adjusted? (a) How is this adjustment made?

Ans. Six inches. (a) By first forcing the push rod into the cylinder as far as it will go; make a chalk mark on push rod next to piston sleeve; wind the hand brake taut. The distance the chalk mark travels will equal piston travel. Take up slack with brake levers.

324. What is the least travel to which driver brake pistons should be adjusted on three or more pairs of driving wheels (trailers included), and how is this adjustment made?

Ans. Five inches. Adjust by applying the brake and measuring the travel of piston sleeve.

325. What is the objection to long piston travel?

Ans. It reduces the braking power.

326. What is the objection to very short piston travel?

Ans. It is destructive to the equipment; it must travel three inches to cover leakage groove or air will leak out of cylinder.

327. What makes pistons travel longer after a few days' service?

Ans. Wear of the brake shoes.

328. What machinery forces pistons back into cylinders after brakes have been released?

Ans. Release spring in brake cylinder.

329. How may a stuck brake be bled?

Ans. By opening bleeder valve on auxiliary.

330. What is the last resort for getting air out of a cylinder having a stuck brake?

Ans. By loosening bolts in triple valve casing.

331. Why should passenger train brakes not be released following an emergency application at low speeds?

Ans. Because it is destructive to equipment, especially to draft gear.

332 Why should passenger train brakes be released before coming to a full service stop?

Ans. To avoid shock.

333. When should freight train brakes be released following either a service or emergency stop?

Ans. Release should never be attempted on long trains while in motion without maximum excess pressure, when, after a service reduction brakes can be released with safety at high speed. After emergency application brakes

should not be released until train has come to full stop.

334. Why should freight train brakes not be released at low speeds?

Ans. It is destructive to property and lading. The head brakes would release first; cars in the rear of train being slower to release, it would be liable to damage draft gear.

335. Why should the emergency brakes not be used except in actual emergency cases?

Ans. It is destructive to property and lading.

336. Why should passenger train brakes be applied and released twice for station stops on slippery rails?

Ans. To avoid sliding the wheels.

337. Why should engineers be posted at all times concerning the number and condition of all brakes?

Ans. That judgment may be used accordingly in handling the train.

338. How many freight cars is an engineer permitted to haul up to coal and water station stops without cutting off?

Ans. Twenty or less.

339. Why should brakes be left applied while engine is cut off for taking on coal or water?

Ans. To prevent train or engine from moving from any cause.

340. Why should engineers blow air through each hose cock at rear of tender before leaving roundhouse tracks for a trip?

Ans. To blow dirt out of couplings and ascertain if the air is passing through the pipes.

341. Should the sand be applied before or after brakes have been set for a service stop on slippery rails?

Ans. Before.

342. Which should an engineer apply first —the sand or brakes—in emergency cases?

Ans. The brakes, and the sand as soon thereafter as possible.

343. Explain conditions air appliances must be placed in, on second engine of a double-header.

Ans. The double-head cock beneath brake valve on second engine must be kept closed, handle of brake valve left in running position and full pressure maintained in main reservoir.

344. How may you cut out a brake?

Ans. Turn cut-out cock on branch pipe and bleed air out of auxiliary.

345. Why must there be at least two good quick acting triple valves next to tender?

Ans. So that brakes can be applied in emergency if necessary.

346. How many cut out brakes may be run coupled together among other good brakes?

Ans. Never more than two.

347. Explain the open and closed position for the handle of an angle cock.

Ans. Open when handles are lengthwise, and closed when crosswise.

348. Why must angle cocks be opened gently when coupling cars having air pressure?

Ans. To avoid throwing triple into emergency position.

349. Explain the open and closed position for the handle of a signal hose cock.

Ans. Closed when lengthwise, and open when crosswise.

350. What is the purpose of a retaining valve and where is it located on a car?

Ans. To retain fifteen pounds pressure in brake cylinder while auxiliary reservoir is being recharged; is used in descending heavy grades. It is located on top and end of car near hand brake staff.

351. Explain the position for retaining valve handle when not in use.

Ans. Handle always points down.

352. How much pressure does a retaining valve hold when its handle points out?

Ans. Fifteen pounds.

353. Where is this pressure retained?

Ans. In brake cylinder.

354. When air blows continually from a retaining valve is it out of order, or is it the triple valve beneath the car?

Ans. It is the triple valve.

355. What will happen to a brake if you turn up retaining valve to stop a leak?

Ans. The air that is leaking will be retained in brake cylinder until 15 pounds pressure has been reached, when retaining valve will lift and air will leak past retaining valve the same as before turning it up.

356. Must retaining valves be operated next to the engine or the caboose when going down grades?

Ans. Next to engine.

357. Who is to direct the number of retaining valves to be used?

Ans. The engineer.

358. Must extra hose complete be carried on engine for the different train pipes?

Ans. Yes.

359. Must the raised figures indicating the date of both their application and removal be cut off each hose?

Ans. Yes.

360. How may a signal hose and fittings be distinguished?

Ans. By the word signal cast on the body.

361. What must be done with a burst hose which has caused damage to person, lading or property?

Ans. The conductor will send the hose carded and a letter of all other information to his superior officer.

362. Will any excuse be acceptable for starting out with a train without first testing the brakes?

Ans. No.

363. Should brakes be tested by rear hose-cock, or by brake valve on engine?

Ans. By brake valve on engine.

364. Can the air brakes be depended upon to hold engine or cars when standing?

Ans. No, not very long.

365. How may brakes be applied from second engine in case of an emergency?

Ans. Place brake handle in emergency position, cut in double-head valve under brake valve.

366. From where is air taken to supply water tanks under Pullman cars?

Ans. Auxiliary reservoir.

367. What pressure is carried in train signal apparatus and where is the adjustment made?

Ans. Forty pounds. Is adjusted with air signal reducing valve located in cab.

368. Which valve is out of order when whistle sounds each time brake valve handle has been moved to release position?

Ans. Reducing valve.

369. Which valve is out of order if the whistle sounds more than once for each pull of the cord from a coach?

Ans. Whistle signal valve.

370. Explain all positions for the handle of the straight air brake valve.

Ans. With the New York valve there are four positions: release, lap, service and emergency. Westinghouse has three: release, lap and application.

371. To what pressure is the straight air brake controlling valve adjusted?

Ans. Forty pounds.

372. Should a straight air hose between engine and tank burst, would it affect the automatic action of engine and tender brakes?

Ans. No.

373. To what pressure are the safety valves on driver and tender brake cylinders adjusted?

Ans. Not to exceed fifty-three pounds.

374. If safety valves blow when straight air has been fully applied, what is the trouble?

Ans. It indicates leaky or too high adjustment of the reducing valve; leaky, or too low adjustment of the safety valves.

375. Should the automatic train brakes or the locomotive straight air brake be applied first when slowing down or stopping trains?

Ans. The automatic.

376. Which should be released last?

Ans. Straight air.

377. Where should handle of straight air brake valve be carried when not in use?

Ans. In release position.

378. From what source do the air signal, fire door opener, bell ringer, track sanders and straight air brake receive their pressure?

Ans. From main drum.

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